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Unit organization of the topic fractions in first year algebra

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UNIT ORGANIZATION OF THE TOPIC FRACTIONS IN FIRST YEAR ALGEBRA

Submitted by

Alfred Fullick Gay

(B.S., Massachusetts State College, 1924)

In partial fulfillment of requirements for

the degree of Master of Education

1945

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CHAPTER I

THE PROBLEM : DESCRIPTION OF THE CLASS AND OF THE COURSE

Each year at the Belmont Senior High School a course in first-year algebra is offered for those who did not take it in grade nine, or who did not receive a passing mark in it. Those electing this subject do so because they hope to go on with the regular course in high school mathematics, or because they think they will need it to carry on some other subject, such as chemistry or physics.

The group electing this subject for the 1944-1945 school year ranged from fifteen to eighteen years in age, with those sixteen years old being the most numerous. There were thirty-one pupils in the group. Since five of the group entered from other schools, records of intelligence quotients were available for only twenty-six members. The range in intelligence quotients was from 88 to 141 for those known. So far as their mark in their last course in mathematics is concerned the information is not so encouraging. Five of the group failed algebra last year, and five more dropped to avoid failure. Twelve took no mathematics last year, and of

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the nine remaining, one received a rank of A, four a rank of B, three a rank of C, and one a rank of X. Table I which follows at the end of this chapter lists the above information in detail.

The preceding information and that contained in Table I, while encouraging from the standpoint of intelligence quotients, was discouraging, when one considered the past records of a large portion of the group in regard to mathematics. A small number of the group were able and anxious to do good work, but the majority of the class had to be led or driven with considerable more than usual individual help and encouragement. Many of the latter type were inclined to give up quickly at small difficulties.

Our problem, in working with such a group annually, is to develop a method which will be more effective than that used to date in caring for the wide variation in needs and abilities of the pupils electing this course. All of their previous work in mathematics has been taught by the use of the traditional daily assignment. With this group progress and achievement has not been quite on a par with the average ninth-grade section.

This paper is a record of the organization of the topic fractions by the unit method,[1/] and of all the experiences involved in teaching and testing this topic.

1/ As developed in Roy O. Billett's, Fundamentals of Secondary-School Teaching, and in the course in the Unit Method at Boston University.

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Table 1. Description of the Class Members.

Pupil	Intelligence Quotient	Age	Mark in Mathematics Last Year
1	141	15	B
2	135	16	*
3	133	15	*
4	132	15	*
5	130	15	A
6	128	17	B
7	125	17	dropped
8	124	17	failed
9	123	16	X
10	120	17	*
11	118	15	dropped
12	114	16	failed
13	110	18	C
14	110	16	dropped
15	107	16	*
16	106	15	failed
17	105	16	dropped
18	104	17	failed
19	103	17	B
20	102	16	*
21	100	16	*
22	99	16	dropped
23	99	16	*
24	93	16	C
25	90	17	B
26	88	17	failed
27	--	16	*
28	--	17	*
29	--	15	*
30	--	16	*
31	--	15	C

* No course in mathematics last year.

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8	124	17	failed
9	123	16	A
10	120	17	*
11	118	15	dropped
12	114	15	failed
13	110	18	C
14	110	16	dropped
15	107	16	*
16	106	15	failed
17	105	18	dropped
18	104	17	failed
19	103	17	B
20	102	16	*
21	100	16	*
22	99	16	dropped
23	99	16	*
24	93	16	C
25	90	17	B
26	88	17	failed
27	--	16	*
28	--	17	*
29	--	15	*
30	--	16	*
31	--	15	C

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CHAPTER II

ORGANIZING THE UNIT AND THE UNIT ASSIGNMENT

In organizing the topic fractions in first-year algebra for the class described in Chapter I, I have followed the principles of unit construction as given in 'Fundamentals of Secondary-School Teaching' by Roy O. Billett. This calls for planning two sequences. The first, called a unit, is a "statement of the changes to be sought in the pupils' capacities for and tendencies toward behavior".[1/] The second sequence, called the unit assignment, is "the general plan for the guided and directed experience by means of which the hoped-for changes may be brought into existence".[2/]

The unit and unit assignment which follow are given as actually used with the class previously described.

The Unit

It is necessary for one to understand what fractions are and how to use them before one can continue profitably with mathematics, such as advanced algebra, geometry, trigonometry and the like; or with the sciences, such as physics or chemistry.

1/ P. 504

2/ P. 504

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Delimitation of the Unit

1. A fraction is an indicated quotient in which the dividend is the numerator and the divisor is the denominator.
2. The fundamental principle of fractions is that the value of a fraction is not changed when both numerator and denominator are multiplied or divided by the same expression.
3. A fraction is reduced to lowest terms by dividing both numerator and denominator by the product of all the common factors. It is often necessary to factor both terms before this can be done.
4. Two or more fractions are multiplied by writing the product of the numerators over the product of the denominators, both in factored form, and then proceeding as if reducing to lowest terms.
5. To divide by a fraction invert the divisor and proceed as in multiplication.
6. In adding or subtracting fractions there are two cases: (a) If the fractions have the same denominator add or subtract the numerator and write the result over the denominator; (b) if the denominators are unlike, then the fractions must be changed to equivalent fractions having the same denominator, and then proceed as in (a).

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7. Mixed expressions are changed to fractions by following the method used for adding or subtracting fractions.
8. Since a fraction is an indicated quotient three signs must be considered: the sign of the numerator, the sign of the denominator, and the sign before the fraction. Following the rule of signs for division, any two of these signs may be changed without changing the value of the fraction.
9. Complex fractions are those which have one or more fractions in either the numerator or the denominator, or both. They are most easily simplified by multiplying the numerator and the denominator by the lowest common denominator of all the fractions appearing in the given complex fraction.

Indirect Learning Products

1. A better understanding of, and increased skill with, arithmetic operations involving fractions.
2. Further practice and actual application of previous work with factoring.

References for Teacher's Use

Betz, William. Algebra For Today - First Year. Ginn and Company, Boston, 1941.

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Hart, Walter W. Progressive First Algebra. D. C. Heath and Company, Boston, 1934.

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Schorling, Raleigh, John R. Clark and Rolland R. Smith. First-Year Algebra. World Book Company, New York, 1944.

Stone, Charles A. and Joel S. Georges. Unit Workbook In Algebra. Allyn and Bacon, Boston, 1943.

The Unit Assignment (Tentative time allotment, four weeks).

A. Introduction

Two periods to be used to orient the pupil in the unit. The following steps to be done by the teacher to accomplish this:-

1. An explanation of the importance of fractions. Since fractions occur so often in later topics in algebra, such as fractional equations, numerical trigonometry, radicals; and in sciences, such as physics, in mechanics, electricity, light and sound, one needs to know the fundamentals of their use.
2. Give a pre-test to find out what the pupils already know about fractions, and which will serve as a basis for comparison at the completion of the unit.
3. Give the pupils a brief explanation of each of the following understandings and operations which they

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2. Give a pre-test to find out what the pupils already know about fractions, and which will serve as a basis for comparison at the completion of the unit.
3. Give the pupils a brief explanation of each of the following understandings and operations which they

are to study in this unit. These will each be more fully explained later.

a. What a fraction is.

b. How fractions are reduced.

c. How fractions are multiplied and divided.

d. How fractions are added and subtracted.

e. What mixed expressions are.

f. What signs must be considered with fractions.

g. What a complex fraction is.

4. Give out study guides. Read them through with the pupils and answer their questions. Tell how the practice material and progress tests and retests should be used.

5. Call attention of the pupils to the optional activities and to their purpose.

6. Give notice that two periods will be saved at the end of the unit for the sharing of class experiences, for discussion of optional activities done by pupils, and for an opportunity to clear up any questions pupils may have by that time.

7. Explain to pupils that a mastery test over all the unit will be given on the final day of the time allotted.

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B. The Study Guide

I. General Directions

In your work with fractions you will be permitted to proceed at your own rate. It should not be necessary for you to do all of the examples given in the text for each new understanding and process with fractions. Do enough examples in each practice set so that you feel certain that you have mastered that process. Self-administering tests will be available for each process. It is suggested that where possible these be taken before starting a new process or problem to be sure that you are making satisfactory progress. If after taking any of these progress tests the results are unsatisfactory, further practice should be obtained by doing more of the exercises either in your own text or in those additional texts which will be available. A second progress test for the same process should be taken. A test covering all the understandings and processes in the entire unit will be given a day or two before the end of the time allotted for the unit. In addition to all the basic processes most of you will wish to work on one or more of the optional activities which are available. In doing the problems and practice work which follows, it will not be necessary to do all of it in the order

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given below. However, those who do change the order should first consult with the instructor.

Text: Betz - Algebra For Today - First Course

II. Problems and Practice Work

1. (a) What is a fraction? In what respects do the fractions used in algebra differ from those in arithmetic?

   (b) Practice work--Page 353-4.

2. (a) What are equivalent fractions?

   (b) Practice work--Page 355-6.

   (c) Progress test number one.

3. (a) How do you know when a fraction has been reduced to its lowest terms?

   (b) Practice work--Page 357-8.

   (c) Progress test number two.

4. (a) How are fractions multiplied?

   (b) Practice work--Page 360-1.

5. (a) How are fractions divided?

   (b) Practice work--Page 363-4.

   (c) Progress test number three.

6. (a) How are fractions having the same denominator added or subtracted?

   (b) Practice work--Page 364-5.

7. (a) What is the lowest common denominator and how is it obtained?

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5. (a) How are fractions divided?

   (b) Practice work--Page 362-4.

   (c) Progress test number three.

6. (a) How are fractions having the same denominator added or subtracted?

   (b) Practice work--Page 364-5.

7. (a) What is the lowest common denominator and how is it obtained?

(b) Practice work--Page 367-8.

8. (a) How are fractions having different denominators added or subtracted?

(b) Practice work--Page 369-372.

(c) Progress test number four.

9. (a) What are mixed expressions?

(b) Practice work--Page 373.

10. (a) What signs must be considered when working with fractions? What basic rule should you follow when changing the signs in a fraction?

(b) Practice work--Page 375.

11. (a) What is a complex fraction?

(b) Practice work--Page 377.

(c) Progress test number five.

12. General review of the unit--Page 378.

13. Mastery test on the entire unit.

C. Optional Related Activities

1. Make a collection of at least ten formulas in the fraction form from two or more subjects other than algebra. Identify each of these by name; and, if not too involved, explain its use, or show how one or more of the processes studied in this unit apply to it.

<u>References</u>

Black and Davis - <u>Elementary Practical Physics</u>

Black and Conant - <u>Elementary Practical Chemistry</u>

(b) Practice work--Page 367-8.

8. (a) How are fractions having different denominators added or subtracted?

(b) Practice work--Page 369-372.

(c) Progress test number four.

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Black and Conant - <u>Elementary Practical Chemistry</u>

Dull, Newlin - Fundamentals of Machines

Dull, Newlin - Fundamentals of Electricity

2. Prepare a progress test on one or more of the main processes for this unit. Also, prepare a set of answers for this test.

   References

   See three or more of the algebra texts available on the table in the front of the room.

3. Examine the portion of your text not yet studied and prepare a list of topics which require an understanding of fractions. Select one of these and explain what practical use it might have.

4. Make a selection of six or eight examples from this unit which make use of one or more of the four types of factoring which you have studied. Identify by name, in each case, the type of factoring involved, and then show the complete solution of the example.

5. Make a collection of illustrations, from reading of your own magazines or books, which are fractions in some form. Try to make a collection which will show the importance of an understanding of fractions.

6. Prepare a list of special difficulties which you or other pupils have met in working with fractions. Show how these difficulties are handled.

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6. Prepare a list of special difficulties which you or other pupils have met in working with fractions. Show how these difficulties are handled.

7. Any worthwhile activity connected with fractions and suggested by a pupil. Consult the teacher before going too far with this.

CHAPTER III

TEACHING THE UNIT

A. A Log of the Teacher's Experiences and Observations

The work on the unit began by following out the procedure as planned in the introduction to the unit assignment (A). Before going into the details of what took place during the teaching of the unit, the room in which the class met should be mentioned briefly as some features of it aided in this departure from the conventional recitation and assignment. The chief difference between it and other classrooms was the fact that it was about twice as large. It contained sixty seats and desks for home-room purposes, but when used as a classroom it was assigned only the usual twenty to thirty pupils. This feature of size made the room particularly useful when putting the unit into actual practice. Those who wished to take any of the progress tests were able to do so at the front of the room, and yet did not have to occupy adjacent desks. Meanwhile the rest of the class could move to the back of the room to work either or in groups of two or three without disturbing those taking the tests. This flexibility of seating arrangement made the attempt to teach a class of thirty-one by the unit method much more feasible.

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A. A Log of the Teacher's Experiences and Observations

The work on the unit began by following out the procedure as planned in the introduction to the unit assignment (A). Before going into the details of what took place during the teaching of the unit, the room in which the class met should be mentioned briefly as some features of it aided in this departure from the conventional recitation and assignment. The chief difference between it and other classrooms was the fact that it was about twice as large. It contained sixty seats and desks for home-room purposes, but when used as a classroom it was assigned only the usual twenty to thirty pupils. This feature of size made the room particularly useful when putting the unit into actual practice. Those who wished to take any of the progress tests were able to do so at the front of the room, and yet did not have to occupy adjacent desks. Meanwhile the rest of the class could move to the back of the room to work either or in groups of two or three without disturbing those taking the tests. This flexibility of seating arrangement made the attempt to teach a class of thirty-one by the unit method much more feasible.

Twenty class periods were used on this unit and were spread over five school weeks. As a matter of fact work on the unit did not get off to the best possible start. We began on May 7 with a discussion of the importance of fractions and the pre-test was given during the last half of the period. It was pointed out to the pupils that this would show not only what they already knew about fractions, but also, to a limited extent, what they were about to study. When corrected and returned to the pupils they were to take particular notice of the types of work which gave the most difficulty, so that in their work on the unit they would know what to emphasize most. Since on May 8 our school closed early because of V-E Day we made no progress. On May 9 we discussed the pre-test, and then spent the rest of the period looking over the study guide and answering questions in regard to its use. May 10 was lost to us also because on that day Cooperative Tests were given to all classes in mathematics. All of these interruptions, while justifiable, meant that the greater portion of the class did not get down to serious work on the unit at all this first week, as only one day of it remained. The final day of this first week found nine pupils ready to take progress test number one, while the rest of the class did practice work (see study guide) in the back of the room. This was the first real work period on the unit, due to the reasons previously given. The pupils

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studying at the back of the room tended to take advantage of the new freedom allowed by this type of assignment, and were noisier than they should have been. Those taking the progress test found the fourth question not clear when they tried to list the parts of the answer. Also, a couple more examples like the last two would have made it more certain that an understanding of equivalent fractions had been gained.

The second week was more productive as we had no interruptions in our regular schedule. Part of the first period of this week was used to discuss with the class the best procedure to follow each day during the rest of the time for the unit. It was agreed that the following general plan would be used:- (1) at the start of each period pupils were to take their usual seats for checking of attendance; then (2) pupils wishing to take a progress test were to take seats at the front of the room, while the rest of the class were to go to the back of the room to continue practice work; and (3) pupils who had taken a progress test the previous day were to have a chance to confer with the teacher to learn the results of the test and to have errors pointed out, and if necessary to be assigned more practice material to do before taking a retest. At the same time a brief discussion was held concerning pupil responsibility for maintaining reasonable quiet for good working conditions. On the second day of this week all members of the class had completed

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progress test number one and a few had passed number two. On Wednesday about fifteen minutes of the period were taken by the teacher to demonstrate to the entire class how to use factoring in the reduction of fractions, and also in multiplication and division. The big difficulty met by most pupils was in the difference in procedure between fractions having monomial terms and those with polynomial terms. The fourth day of the week began with a short discussion emphasizing the importance of the main questions and understandings to be sought as outlined on the study guide. None of the pupils attempted to change the order of practice work from that given on the study guide, even though such variation was entirely possible. This discussion was prompted by the fact that most of the class had had little practice in planning their own work, and also by the fact that too many from past experience had made the handing in of a daily paper rather than grasp of subject matter serve as their goal. By the final day of this week all but two, who were absent, had successfully completed their work on progress test number two, and ten had completed their work through test number three. The last half of this period was used to demonstrate the finding of the lowest common denominator and its application to the addition and subtraction of fractions. By this time the importance of checking to see that pupils actually had done sufficient

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practice material before taking a progress test was shown. This proved to be rather difficult with a class of thirty-one. About a fourth of the pupils were working now for the fourth test, on addition and subtraction; while the majority were still working on multiplication and division, with two others still working on reduction.

Progress was much slower the third week, chiefly due to the fact that addition and subtraction of fractions is difficult for most pupils. This difficulty was magnified by the fact that ten of the class on the pre-test showed that they knew little or nothing about addition and subtraction of fractions. We used two of the periods this week working as a whole class demonstrating how to do this work in all its details. Some of this was done by teacher demonstration and much by the pupils. About one fourth of the class completed work through progress test number four before the week ended.

The first day of the fourth week was used by the majority of the class in taking progress test number four on addition and subtraction. Those who had completed this the previous week began work on the final topics - mixed expressions, signs in fractions, and complex fractions. The next day was used in demonstrating the above topics to the entire class for about half of the period, and the rest of the time was used in reporting to individual pupils their

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results on test four with additional assignments for those who did poorly with it. Wednesday was lost to us because of Memorial Day, and Thursday because of an assembly. About one-third of the class passed progress test number five (the final one) by the end of this week, and began work on some of the optional activities. Not all wished to do these, because being optional they failed to see any immediate advantage for themselves. As I pointed out in Chapter I the class is one which would not be apt to do any more than was absolutely required. Those who did not attempt the optional activities began a review of the entire unit for the mastery test.

The first two days of the fifth week were used to complete the taking of all remaining progress tests and the necessary retests. Wednesday was used as a period in which to share experiences. This gave those who did any of the optional activities a chance to report to the entire class so that all might benefit. The following reports were given:- (1) a summary, with illustrations, showing all the types of factoring necessary in working with fractions; (2) a report showing the importance of fractions in the study of physics, with ten formulas as illustrations, three of these being in the form of complex fractions; (3) a mastery test on the entire unit prepared by one of the boys was of much interest as it gave a good idea of what to expect on the actual test;

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(4) a paper showing illustrations of each of the types of work with fractions studied in the unit; and (5) an essay on 'The Importance of Mathematics'. Only eight members of the class did an optional topic. Their papers were all posted on the class bulletin board, where they proved to be of interest not only to this class but also to others meeting in the room. The last part of the same period was used in outlining what to expect on the mastery test. This was given the next day. Originally it was planned to have one more day for the sharing of experiences and class review; but due to an assembly scheduled for the final day of the week, it seemed best to give the mastery test on Thursday.

The first of the following week the pre-test was repeated to see what gains the pupils had made. On another day a questionnaire was given to try to get pupil reaction to this method of assigning work.

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B. Achievement of Pupils As Measured by a Series of Objective Tests

In this section will be found a copy of each test given during the unit. This includes a copy of the pre-test, one of each of the progress tests and retests, and one of the mastery test. Scores and dates when the tests were taken are given in each case.

Pre-Test Fractions Algebra I Answers

1. (a) How many terms are there in a simple fraction? 1(a)
(b) Name these terms. (b)

2. Reduce to lowest terms:

(a) $\frac{21}{24} =$ (c) $\frac{5ad}{30cd} =$ 2(a)

(b) $\frac{45}{360} =$ (d) $\frac{2x+3}{10x+15} =$ (b)

(c)

(d)

3. Change to a mixed number:

(a) $\frac{45}{8} =$ (c) $\frac{2n^2-3n+5}{n-3} =$ 3(a)

(b) $\frac{49}{4} =$ (b)

(c)

4. Change to the fraction form:

(a) $3\frac{1}{2} =$ (c) $x - \frac{z}{y} =$ 4(a)

(b) $3\frac{3}{16} =$ (b)

(c)

5. Addition & Subtraction of fractions:

(a) $\frac{7}{8} - \frac{3}{4} + \frac{1}{2} =$ 5(a)

(b) $\frac{1}{5x} - \frac{1}{6 \cdot y} =$ (b)

Pre-Test Fractions Algebra I Answers

5. (c) $8\frac{5}{8}$ 5(c)

add $4\frac{1}{3}$ (d)

(d) $\frac{1}{a+3} - \frac{1}{a-3} =$

6. Multiplication & Division of fractions:

(a) $\frac{7}{8} \times \frac{28}{49} =$ 6(a)

(b) $88 \div 3\frac{1}{7} =$ (b)

(c) $\frac{30 \times 16 \times 9}{24 \times 5} =$ (c)

(d) $\frac{b}{2} \times \frac{8a}{17b} =$ (d)

(e) $\frac{mn}{a-b} \times \frac{a^2-b^2}{m^2} =$ (e)

7. Change to simplest form: 7(a)

(a) $\frac{\frac{1}{3}}{8} =$ (b)

(b) $\frac{\frac{1}{2}+\frac{1}{4}}{2\frac{1}{2}} =$ (c)

(c) $\frac{n}{9-\frac{1}{3}} =$

Table 2. Scores on Pre-Test by Parts and Total

Pupil	I a/	II	III	IV	V	VI	Total
28	2	3	5	2	4	3	19
31	2	3	5	2	4	1	17
2	1	3	3	2	4	3	16
27	2	3	5	2	4	0	16
10	2	3	4	2	2	2	15
5	2	3	4	2	3	1	15
19	1	3	4	2	4	0	14
12	2	2	3	2	5	0	14
4	2	3	4	1	4	0	14
8	2	2	4	2	3	0	13
22	2	3	4	1	3	0	13
15	2	3	2	2	4	0	13
26	1	3	4	2	3	0	13
25	1	2	4	2	3	0	12
30	1	2	4	2	3	0	12
29	2	2	4	1	1	2	12
24	2	2	4	3	1	0	12
13	1	2	4	2	3	0	12
1	0	3	4	2	3	0	12
14	0	3	4	2	3	0	12
6	1	3	4	2	2	0	12
16	1	2	4	1	4	0	12
21	1	1	4	2	4	0	12
3	1	3	4	1	3	0	12
23	1	2	4	1	3	0	11
20	0	2	3	2	3	1	11
7	2	2	3	1	2	0	10
9	2	3	4	0	1	0	10
11	1	2	4	1	1	0	9
18	1	3	2	0	2	0	8
17	did not take the test						

a/ Part I. Meaning of fractions - two examples.
Part II. Reduction of fractions - four examples.
Part III. Mixed expressions - six examples.
Part IV. Addition and subtraction of fractions - four examples.
Part V. Multiplication and division of fractions - five examples.
Part VI. Complex fractions - three examples.

Table 2. Scores on Pre-Test by Parts and Total

Pupil	I [a]	II	III	IV	V	VI	Total
28	2	3	3	2	4	3	19
21	2	3	3	2	4	1	17
2	1	3	3	2	4	3	16
27	2	3	3	2	4	0	16
10	2	3	4	2	2	2	15
5	2	3	4	2	3	1	15
19	1	3	4	2	4	0	14
12	2	3	3	2	3	0	14
4	2	3	4	1	4	0	14
23	2	3	4	1	3	0	13
15	2	3	4	1	3	0	13
22	2	3	4	1	3	0	13
30	1	3	4	1	3	0	13
29	1	3	4	1	3	0	12
24	2	3	4	1	3	0	12
13	1	3	4	1	3	0	12
1	1	3	4	1	3	0	12
14	0	3	4	1	3	0	12
6	1	3	4	1	3	0	12
16	1	3	4	1	3	0	12
26	1	3	4	1	3	0	12
3	1	3	4	1	3	0	12
25	1	3	4	1	3	0	11
20	1	3	3	1	3	1	11
7	2	3	3	1	2	0	10
9	2	3	4	1	1	0	10
11	1	3	4	1	1	0	9
18	1	3	3	0	2	0	8
17	did not take the test						

[a] Part I. Meaning of fractions - two examples.
Part II. Reduction of fractions - four examples.
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Part IV. Addition and subtraction of fractions - four examples.
Part V. Multiplication and division of fractions - five examples.
Part VI. Complex fractions - three examples.

Algebra I Fractions

Progress Test Number One

Answers

1. Dick can mow a lawn in 40 min. (a) What part of the lawn can he mow in 10 minutes? (b) in x minutes?

2. If Jane pays y cents for 5 bus tickets, how much does each ticket cost her?

3. The length of a rectangle is $(r-7)$ feet and the width is one third of the length. Express the width in terms of the length.

4. If $x = 3$; arrange the following fractions in order of size, starting with the smallest:

$$\frac{1}{x+4}, \quad \frac{1}{3x}, \quad \frac{4}{5x-3}, \quad \frac{8}{12x+4}$$

Supply the missing term in each of the following:

5. $\frac{7}{8} = \frac{\quad}{32}$

6. $\frac{6a^2x^2}{36a^3x} = \frac{\quad}{x}$

7. $\frac{2}{a+b} = \frac{\quad}{4(a+b)}$

8. $\frac{9n}{2n-5} = \frac{18n}{\quad}$

9. $\frac{c+5}{c-5} = \frac{\quad}{c^2-25}$

10. $\frac{x+2}{x} = \frac{\quad}{x^2+5x}$

1. _____
_____
2. _____
3. _____
4. _____
_____
_____
_____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Table 3. Scores - Progress Test Number One[a/]

Pupil	Date	Score	Mark
27	5-14	9	A-
5	5-11	9	A-
6	5-11	9	A-
9	5-14	9	A-
15	5-11	9	A-
26	5-15	9	A-
29	5-11	9	A-
17	5-14	8	B
16	5-14	8	B
30	5-14	8	B
8	5-14	8	B
24	5-15	8	B
4	5-14	8	B
3	5-14	8	B
19	5-14	7	C
23	5-14	7	C
7	5-14	7	C
14	5-15	7	C
20	5-11	7	C
28	5-11	7	C
21	5-11	7	C
22	5-14	7	C
10	5-15	5	X
18	5-11	5	X
13	5-15	5	X
31	5-16	5	X
2	5-11	5	X
12	5-11	4	D
1	5-15	4	D
25	5-15	incomplete	
11	5-15	incomplete	

a/ Highest possible score - 10.

Table 2. Scores - Progress Test Number One [a]

Pupil	Date	Score	Mark
27	5-14	9	A-
5	5-11	9	A-
6	5-11	9	A-
9	5-14	9	A-
13	5-11	9	A-
26	5-15	9	A-
22	5-11	9	A-
17	5-14	8	B
15	5-14	8	B
30	5-14	8	B
8	5-14	8	B
24	5-15	8	B
4	5-14	8	B
3	5-14	8	B
19	5-14	7	C
23	5-14	7	C
7	5-14	7	C
14	5-15	7	C
20	5-11	7	C
28	5-11	7	C
21	5-11	7	C
25	5-14	7	C
10	5-15	6	X
18	5-11	6	X
12	5-15	6	X
31	5-15	6	X
2	5-11	6	X
12	5-11	4	D
1	5-15	4	E
29	5-15	incomplete	
11	5-15	incomplete	

a/ Highest possible score - 10.

Progress Test Number One (A)

Answers.

1. Arrange the fractions $\frac{1}{4}, \frac{1}{12}, \frac{1}{2}, \frac{1}{6}, \frac{1}{50}$ in order of size, from the largest to the smallest. 1.

2. A motorist covered a distance of $50x$ miles in y hours. At what hourly rate did he travel? 2.

3. If d pencils cost m cents, (a) how much will x pencils cost? (b) how many pencils can you buy for y cents? 3. (a) (b)

Supply the missing term in each of the following:-

4. $\frac{3}{7} = \frac{\quad}{28}$

5. $\frac{5bx^2}{35b^2x} = \frac{x}{\quad}$

6. $\frac{3}{r+s} = \frac{\quad}{5(r+s)}$

7. $\frac{4x}{3x-2y} = \frac{16x^2}{\quad}$

8. $\frac{b+c}{3} = \frac{\quad}{3(b-c)}$

9. $\frac{T}{r+s} = \frac{\quad}{r^2-s^2}$

10. $\frac{x+5}{x-2} = \frac{\quad}{x^2-5x+6}$

4.
5.
6.
7.
8.
9.
10.

Table 4. Scores - Progress Test Number One A[a/]

Pupil	Date	Score	Mark
25	6- 4	9	A-
12	5-14	7	C
11	6- 4	5	X
18	5-16	5	X

a/ Highest possible score - 10.

Table 4. Scores - Progress Test Number One a/

Pupil	Date	Score	Mark
25	6- 4	9	A-
12	5-14	7	C
11	6- 4	5	X
18	5-16	5	X

a/ Highest possible score - 10.

Algebra I Fractions

Progress Test Number Two

Reduce to lowest terms:-

1. $\dfrac{10ab}{15b^2} =$

2. $\dfrac{-32xy^2}{24x^2y} =$

3. $\dfrac{27x^3y^2}{81xy^3} =$

4. $\dfrac{2x+3}{10x+15} =$

5. $\dfrac{4x^2-1}{4x+2} =$

6. $\dfrac{am+bm+cm}{am+bm+cm} =$

7. $\dfrac{x^2-2x-15}{x^2-3x-10} =$

8. $\dfrac{a^2+2a-8}{a^2+4a-12} =$

9. $\dfrac{3a^2-6a}{9a^2-36} =$

10. $\dfrac{x^3-7x^2+6x}{2x^2-10x-12} =$

Table 5. Scores - Progress Test Number Two [a]

Pupil	Date	Score	Mark
28	5-15	9	A-
16	5-16	9	A-
21	5-15	9	A-
6	5-15	8	B
15	5-15	8	B
4	5-16	8	B
25	5-16	7	C
19	5-15	7	C
27	5-15	7	C
9	5-15	7	C
2	5-29	7	C
3	5-16	7	C
23	5-17	6	X
5	5-15	6	X
8	5-21	6	X
13	5-18	6	X
14	5-17	6	X
17	5-16	6	X
26	5-16	6	X
30	5-17	5	X
18	5-17	5	X
24	5-17	5	X
7	5-15	4	D
29	5-14	4	D
1	5-17	4	D
11	5-18	4	D
10	5-21	3	D
12	5-14	3	D
22	5-18	3	D
20	5-14	2	D
31	5-23	2	D

a/ Highest possible score - 10.

Table 5. Scores - Progress Test Number Two [a]

Pupil	Date	Score	Mark
28	5-15	9	A-
16	5-16	9	A-
21	5-15	9	A-
6	5-15	8	B
15	5-15	8	B
4	5-16	8	B
29	5-16	7	C
19	5-15	7	C
27	5-15	7	C
9	5-15	7	C
2	5-29	7	C
3	5-16	7	C
23	5-17	6	X
5	5-15	6	X
8	5-21	6	X
13	5-18	6	X
14	5-17	6	X
17	5-15	6	X
25	5-16	6	X
30	5-17	6	X
18	5-17	6	X
24	5-17	6	X
7	5-15	5	D
22	5-14	5	D
1	5-17	5	D
11	5-18	5	D
10	5-21	5	D
12	5-14	5	D
26	5-18	5	D
20	5-14	5	D
31	5-28	5	D

a/ Highest possible score - 10.

Progress Test Number Two (A)

Reduce to lowest terms:-

1. $\dfrac{27xy}{36y^2} =$

2. $\dfrac{24mn^2}{-96m^2n} =$

3. $\dfrac{18ab^2c^3}{42a^3bc^3} =$

4. $\dfrac{16(a-b)}{32c(a-b)} =$

5. $\dfrac{4n-4a}{14(n-a)} =$

6. $\dfrac{xz+yz}{x^2-y^2} =$

7. $\dfrac{a^2+3a-10}{a^2-10a+16} =$

8. $\dfrac{2x^2+3x-2}{2x^2-x} =$

9. $\dfrac{3x^2-12}{3x^2-3x-6} =$

10. $\dfrac{a^2-b^2}{a^2+2ab+b^2} =$

Table 6. Scores - Progress Test Number Two A [a/]

Pupil	Date	Score	Mark
29	5-16	10	A
1	5-23	8	B
12	5-16	8	B
14	5-21	8	B
30	6- 5	8	B
11	5-23	7	C
5	6- 4	6	X
7	5-21	6	X
20	5-16	6	X
31	5-29	6	X
17	5-23	4	D

a/ Highest possible score - 10.

Table 6. Scores - Progress Test Number Two A [a]

Pupil	Date	Score	Mark
29	3-16	10	A
1	3-23	8	B
12	3-16	6	B
14	3-21	6	B
30	3- 3	8	B
11	3-23	7	C
3	3- 4	6	X
7	3-21	6	X
20	3-16	6	X
31	3-23	6	X
17	3-23	4	D

a/ Highest possible score - 10.

Algebra I Fractions.

Progress Test Number Three

Multiply or Divide the following as indicated:-

Answers

1. $\frac{5a^2}{8ab} \cdot \frac{12ab^2}{10a^2} =$

1.

2. $12xy^2 \div \frac{15x^2y}{21x} =$

2.

3. $\frac{x^2-2x}{x^2+x-6} \times \frac{x+3}{x^3} =$

3.

4. $\frac{a(x-3)^2}{5b} \div \frac{a(x^2-9)}{5b} =$

4.

5. $\frac{2a^2+a-6}{a^2-4} \cdot \frac{12}{6a-9} \cdot \frac{3a^2-5a-2}{4} =$

5.

6. $\frac{4(m^2+2m-15)}{m^2+2m-3} \div \frac{2m^2+10m}{m^3-m} =$

6.

Table 7. Scores - Progress Test Number Three [a]

Pupil	Date	Score	Mark
29	5-18	6	A
21	5-16	6	A
9	5-21	5	B
25	5-23	5	B
6	5-18	5	B
16	5-21	5	B
4	5-21	5	B
19	5-18	4	C
30	5-23	4	C
27	5-16	4	C
8	6- 1	4	C
13	5-23	4	C
20	5-16	4	C
31	6- 1	4	C
28	5-16	4	C
12	5-21	3	X
18	5-23	3	X
17	5-23	3	X
22	6- 1	3	X
2	6- 1	3	X
15	5-16	3	X
3	5-21	3	X
10	5-28	2	D
5	5-16	2	D
7	5-23	2	D
24	5-23	2	D
1	5-24	2	D
11	6- 1	2	D
26	5-18	2	D
23	5-18	1	D
14	5-23	1	D

a/ Highest possible score - 6.

Table 7. Scores - Progress Test Number Three a/

Pupil	Date	Score	Mark
29	5-18	6	A
21	5-16	5	A
9	5-21	5	B
23	5-23	5	B
6	5-18	5	B
16	5-21	5	B
4	5-21	5	B
19	5-18	4	C
30	5-21	4	C
27	5-16	4	C
8	5- 1	4	C
13	5-23	4	C
20	5-16	4	C
31	5- 1	4	C
28	5-16	4	C
12	5-21	3	X
15	5-23	3	X
17	5-23	3	X
22	6- 1	3	X
25	6- 1	3	X
15	5-16	3	X
3	5-21	3	X
10	5-23	2	D
5	5-16	2	D
7	5-23	2	D
24	5-23	2	D
1	5-24	2	D
11	6- 1	2	D
26	5-18	2	D
28	5-18	1	D
14	5-23	1	D

a/ Highest possible score - 6.

Progress Test Number Three (A).

Multiply or Divide the following as indicated:-

1. $\dfrac{(x-y)^2}{z} \div \dfrac{x^2-y^2}{z^2} =$

2. $\dfrac{3b}{c-4d} \cdot \dfrac{5c-20d}{6bd} =$

3. $\dfrac{5(x-4)}{x^2-9} \cdot \dfrac{x-3}{x-4} \div \dfrac{40}{x+3} =$

4. $\dfrac{8a}{m^2} \times \dfrac{am+3m^2}{a-3} \times \dfrac{a^2-9}{2a^2+6am} =$

5. $\dfrac{x^2-4x+3}{35x^2} \times \dfrac{7x^2-7x}{x^2-2x+1} =$

6. $\dfrac{2a^2+7a-15}{2a^2-3a-14} \div \dfrac{8a-12}{2a^2-19a+42} =$

Table 8. Scores - Progress Test Number Three A [a]

Pupil	Date	Score	Mark
27	5-18	6	A
18	5-24	5	B
15	5-18	5	B
26	5-23	5	B
24	5-24	4	C
1	6- 1	4	C
20	5-18	4	C
11	6- 1	4	C
22	6- 1	4	C
12	5-24	3	X
5	5-21	3	X
7	5-24	3	X
23	6- 1	2	D
14	6- 4	1	D

a/ Highest possible score - 6.

Table 8. Scores - Progress Test Number Three a/

Pupil	Date	Score	Mark
27	5-18	6	A
18	5-24	5	B
15	5-18	5	B
28	5-23	5	B
24	6-24	4	C
1	5- 1	4	C
20	5-18	4	C
11	6- 1	4	C
22	6- 1	4	C
12	5-24	3	X
5	5-31	3	X
7	5-24	2	X
23	6- 1	2	D
14	6- 4	1	D

a/ Highest possible score - 6.

Algebra I Fractions

Progress Test Number Four

Combine the following and simplify:-

Answer

1. $\frac{a}{20y} + \frac{9a}{20y} =$ 2. $\frac{16}{x+y} - \frac{10}{x+y} =$

Change to equivalent fractions having the lowest common denominator:

3. $\frac{1}{3}, \frac{2}{5}, \frac{3}{10} =$

4. $\frac{x}{15d^2}, \frac{x}{21d} =$

5. $\frac{5}{x+y}, \frac{20}{x-y} =$

6. $\frac{10n}{s^2-36}, \frac{25}{3s-18} =$

Combine as indicated:-

7. $\frac{12a}{35} + \frac{5a}{7} - \frac{a}{5} =$

8. $\frac{1}{8x^2} - \frac{5}{6xy} - \frac{1}{12y^2} =$

9. $\frac{n-s}{5d} + \frac{n+s}{11d} =$

10. $\frac{5}{3m+6} + \frac{12}{m^2-4} =$

11. $\frac{2x+y}{x-y} + \frac{x}{y} =$

12. $\frac{4m+1}{3m^2-3} + \frac{7}{4m+4} =$

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

Table 9. Scores - Progress Test Number Four [a]

Pupil	Date	Score	Mark
19	5-28	10	B
16	5-23	10	B
27	5-24	9	B
29	5-28	9	B
6	5-28	9	B
30	6- 1	8	C
4	5-24	8	C
26	5-28	8	C
13	6- 1	7	C
1	6- 4	7	C
9	5-24	7	C
3	5-28	7	C
25	5-28	6	X
8	6- 4	6	X
18	5-28	6	X
14	6- 5	6	X
2	6- 4	6	X
21	5-23	6	X
23	5-28	5	X
24	6- 1	5	X
31	5-28	5	X
20	5-24	4	D
15	5-24	4	D
10	6- 1	3	D
12	5-28	3	D
5	5-24	3	D
28	5-21	3	D
7	5-28	2	D
11	5-28	2	D
22	6- 4	2	D
17	6- 4	0	D

a/ Highest possible score - 12.

Table 9. Scores - Progress Test Number Four a/

Pupil	Date	Score	Mark
15	6-28	10	8
16	6-29	10	8
27	6-24	9	8
28	6-28	9	8
6	6-28	9	8
30	6- 1	8	8
4	6-24	8	8
26	6-28	8	8
13	6- 1	7	8
1	6- 4	7	8
9	6-24	7	8
3	6-28	7	8
29	6-28	6	X
8	6- 4	6	X
18	6-28	6	X
14	6- 5	6	X
2	6- 4	6	X
21	6-23	6	X
23	6-28	6	X
24	6- 1	6	X
31	6-28	6	X
20	6-24	4	D
19	6-24	4	D
10	6- 7	3	D
12	6-28	3	D
5	6-24	3	D
28	6-21	3	D
7	6-28	3	D
11	6-28	3	D
22	6- 4	3	D
17	6- 4	0	D

a/ Highest possible score - 12.

Progress Test Number Four A

Combine the following and simplify:-

1. $\frac{11P}{5d} - \frac{5P}{5d} =$

2. $\frac{18}{a+b} - \frac{8}{a+b} =$

Change to equivalent fractions having the lowest common denominator:-

3. $\frac{1}{6}, \frac{1}{5}, \frac{7}{10} =$

4. $\frac{3}{10xy}, \frac{7}{25x^2} =$

5. $\frac{7}{a+b}, \frac{15}{a-b} =$

6. $\frac{9x}{s^2-16}, \frac{16}{3s-12} =$

Combine as indicated:-

7. $\frac{2m}{15} + \frac{13m}{30} - \frac{3m}{10} =$

8. $\frac{c}{c^2} + \frac{3}{2cd} + \frac{2d}{d^2} =$

9. $\frac{2x-3y}{35} + \frac{4x-y}{14} =$

10. $\frac{12}{2m+6} - \frac{7}{m^2-9} =$

11. $\frac{3m+n}{m-n} + \frac{m}{n} =$

12. $\frac{3n+1}{4n^2-4} + \frac{7}{3n+3} =$

Answers

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Table 10. Scores - Progress Test Number Four A [a]

Pupil	Date	Score	Mark
28	5-23	11	A
20	5-28	8	C
5	5-28	7	C
7	6- 1	7	C
15	5-25	5	D
12	6- 1	4	D
11	6- 4	3	D
22	6- 5	3	D
23	6- 4	2	D

a/ Highest possible score - 12.

Table 10. Scores - Progress Test Number Four a/

Pupil	Date	Score	Mark
28	5-23	11	A
20	5-28	8	C
6	5-28	8	C
7	6- 1	7	D
15	5-23	6	D
12	5- 1	4	D
11	6- 4	3	D
22	5- 3	3	D
23	6- 4	2	D

a/ Highest possible score - 12.

Algebra I Fractions
Progress Test Number Five

Answers

Change the following into single fractions:-

1. $x - 1 + \frac{x}{3} =$

2. $2x + 5 - \frac{x}{x-5} =$

3. $x - \frac{x}{x-2} - 4 =$

Express with a positive numerator:-

4. $-\frac{-5a}{a-4} =$

5. $-\frac{-x-2}{x^2-8} =$

Reduce the following fractions:-

6. $\frac{a-5}{5-a} =$

7. $\frac{6-n}{n^2-36} =$

8. $\frac{2b-4}{16-4b^2} =$

Simplify:-

9. $\frac{5}{5-x} - \frac{2x}{x^2-25} =$

10. $\frac{12a}{a^2-16} - \frac{9}{4-a} =$

11. $\dfrac{\frac{4}{5}}{8}$

12. $\dfrac{7-\frac{1}{2}}{10}$

13. $\dfrac{y-\frac{1}{y}}{1+\frac{1}{y}} =$

14. $\dfrac{\frac{x}{3}+\frac{2x}{5}}{\frac{x^2}{5}} =$

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.

Table 11. Scores - Progress Test Number Five [a]

Pupil	Date	Score	Mark
19	6- 1	12	B
20	6- 1	11	B
9	6- 1	11	B
4	6- 1	10	C
30	6- 4	10	C
12	6- 5	9	C
16	5-29	9	C
25	6- 1	8	C
27	6- 4	8	C
6	6- 1	8	C
2	6- 5	8	C
5	6- 1	7	X
8	6- 5	7	X
21	6- 1	7	X
29	6- 1	6	X
24	6- 5	6	X
15	6- 4	6	X
23	6- 1	6	X
1	6- 5	5	D
11	6- 5	5	D
13	6- 1	4	D
31	6- 4	4	D
26	6- 1	4	D
18	6- 1	3	D
22	6- 6	3	D
3	6- 4	2	D
14	6- 5	0	D
7	6- 4	1	D
17	6- 5	0	D
10	left		
28	left		

a/ Highest possible score - 14.

Table II. Scores - Progress Test Number Five [a]

Pupil	Date	Score	Mark
19	6- 1	12	8
20	6- 1	11	8
9	6- 1	11	8
4	6- 1	10	8
30	6- 4	10	8
12	6- 3	9	8
16	6- 29	9	8
22	6- 1	8	8
27	6- 4	8	8
2	6- 1	8	8
5	6- 3	8	8
8	6- 1	7	8
31	6- 1	7	8
24	6- 1	7	8
15	6- 1	6	8
23	6- 4	6	8
11	6- 1	6	8
13	6- 1	6	8
31	6- 4	4	8
28	6- 1	4	8
33	6- 4	3	8
3	6- 4	2	8
14	6- 3	2	8
7	6- 4	0	8
17	6- 3	1	8
10	left	0	8
25	left		

a/ Highest possible score - 14.

Progress Test Number Five (A)

Change the following into single fractions:-

1. $2x + 3 + \frac{5}{x} =$

2. $x - 4 - \frac{x}{x-3} =$

3. $7 + \frac{9}{a} - a =$

Express with a positive numerator:-

4. $-\frac{-3x}{x-2} =$

5. $-\frac{-x-3}{x^2-9} =$

Reduce the following fractions:-

6. $\frac{a-4}{4-a} =$

7. $\frac{x^2-y^2}{2y-2x} =$

8. $\frac{(6-x)^2}{x^2-36} =$

Simplify:-

9. $\frac{5x}{a-4} + \frac{x}{4-a} =$

10. $\frac{7}{10-c} - \frac{2c}{c^2-100} =$

11. $\frac{\frac{3}{5}}{7} =$

12. $\frac{7-\frac{1}{3}}{10} =$

13. $\frac{x-\frac{1}{x}}{1+\frac{1}{x}} =$

14. $\frac{\frac{a}{2}+\frac{2a}{5}}{\frac{a^2}{5}} =$

Answers

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

Table 12. Scores - Progress Test Number Five A [a]

Pupil	Date	Score	Mark
29	6-4	13	A
31	6-5	9	C
15	6-5	6	X
3	6-5	6	X
26	6-4	6	X

a/ Highest possible score - 14.

Table 12. Scores - Progress Test Number Five a/

Pupil	Date	Score	Mark
29	6-4	13	A
31	6-5	9	C
15	6-5	6	X
3	6-5	6	X
26	6-4	6	X

a/ Highest possible score - 14.

Algebra I Fractions
Mastery Test

Supply the missing numerator:-

1. $\frac{3}{8} = \frac{\quad}{24}$

2. $\frac{5}{ac} = \frac{\quad}{abc}$

3. $\frac{3a}{x} = \frac{\quad}{x(x+y)}$

4. $\frac{n+1}{n+7} = \frac{\quad}{n^2+7n}$

5. $\frac{3a-4}{a-1} = \frac{\quad}{(a-1)(a+1)}$

Reduce the following fractions:-

6. $\frac{ad}{ae} = ___$

7. $\frac{27x^3y^2}{81xy^3} = ___$

8. $\frac{3a+3b}{9(a+b)} = ___$

9. $\frac{7w+7}{w^2+2w+1} = ___$

10. $\frac{3b^2-5b+2}{9b^2-4} = ___$

Multiply or Divide as indicated:-

11. $\frac{6a}{5bc} \times \frac{15b^2c^3}{3a^2} =$

12. $\frac{x^2-16}{x+2} \times \frac{x}{x^2-6x+8} =$

13. $\frac{x^2+2x+1}{10x+10} \div \frac{x^2-1}{10} =$

14. $\frac{5(x-4)}{x^2-9} \cdot \frac{x-3}{x-4} \div \frac{40}{x+3} =$

15. $\frac{2a^2+7a-15}{2a^2-3a-14} \div \frac{8a-12}{2a^2-19a+42} =$

Answers

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.

Add or Subtract as indicated:-

Answers

16. $\frac{3}{a} + \frac{2}{b} =$

17. $\frac{4}{3x^2y} - \frac{2}{5ay^3} =$

18. $\frac{2m+5}{4} - \frac{7m-2}{6} =$

19. $\frac{c+d}{c-d} + \frac{c-d}{c+d} =$

20. $\frac{5n+1}{2n^2-2} + \frac{7}{6(n+1)} =$

Change to fractional form:-

21. $2b + 1 + \frac{4}{b} =$

22. $n - 3 - \frac{n+3}{n-3} =$

Simplify the following:-

23. $\frac{a-b}{b-a} =$

24. $\frac{3(2a-3)}{6(3-2a)} =$

25. $\frac{\frac{3}{4}}{\frac{5}{8}} =$

26. $\frac{a - \frac{1}{a}}{1 + \frac{1}{a}} =$

16.

17.

18.

19.

20.

21.

22.

23.

24.

25.

26.

Table 13. Mastery Test Scores

Pupil	I a/	II	III	IV	V	Total	Mark
19	5	5	5	3	5	23	A
6	5	5	4	3	6	23	A
4	5	5	5	3	5	23	A
9	5	5	5	2	5	22	A
29	5	5	4	2	5	21	A
21	4	5	4	2	6	21	A
20	5	4	4	2	5	20	B
16	5	4	5	2	4	20	B
2	5	5	4	1	5	20	B
15	5	4	5	1	5	20	B
27	5	5	4	1	4	19	B
26	5	4	4	0	3	16	C
3	4	5	3	2	2	16	C
25	5	5	3	0	3	16	C
5	4	5	2	1	3	15	C
30	4	5	5	0	1	15	C
23	4	3	3	1	4	15	C
1	4	3	4	2	1	14	X
17	5	4	1	2	1	13	X
22	3	4	4	0	1	12	X
12	5	3	0	0	4	12	X
24	5	3	2	0	2	12	X
8	4	4	2	0	1	11	X
31	1	4	2	0	4	11	X
11	4	4	2	0	1	11	X
14	4	4	2	0	0	10	D
7	3	3	2	0	0	8	D

a/ Part I. Fundamental principle of fractions.
Part II. Reduction of fractions.
Part III. Multiplication and division of fractions.
Part IV. Addition and subtraction of fractions.
Part V. (a) Mixed expressions.
(b) Signs in fractions.
(c) Complex fractions.

There were five examples each in Parts I to IV, and two examples in each part of V.

Table 13. Mastery Test Scores

Pupil	I [a]	II	III	IV	V	Total	Mark
19	5	5	5	3	5	23	A
6	5	5	4	3	5	23	A
4	5	5	5	3	5	23	A
2	5	5	5	2	5	22	A
8	5	5	4	2	5	21	A
22	5	5	4	3	4	21	A
20	4	5	4	3	5	20	B
16	5	4	4	2	5	20	B
1	5	5	4	1	5	20	B
11	5	5	4	1	5	20	B
23	5	5	4	1	4	19	B
5	5	5	4	0	5	19	C
3	5	5	3	2	4	19	C
9	5	5	3	0	5	18	C
30	5	5	3	1	4	18	C
13	4	5	3	0	4	17	C
14	4	5	3	1	4	17	C
7	5	4	4	1	4	18	X
25	5	5	3	1	4	18	X
17	5	4	4	1	3	17	X
12	5	5	4	0	3	17	X
21	5	5	3	0	4	17	X
24	5	5	3	0	3	16	X
8	4	5	3	0	3	15	X
31	4	4	3	0	3	15	X
11	4	4	3	0	3	15	X
14	4	4	3	0	1	12	X
7	3	3	2	0	0	10	D
						8	D

[a] Part I. Fundamental principle of fractions.
Part II. Reduction of fractions.
Part III. Multiplication and division of fractions.
Part IV. Addition and subtraction of fractions.
Part V. (a) Mixed expressions.
(b) Signs in fractions.
(c) Complex fractions.

There were five examples each in Parts I to IV, and two examples in each part of V.

Table 14. Gains Made On Repetition of Pre-Test

Pupil	Gain
9	10
16	9
20	9
4	8
6	7
11	7
15	6
26	6
19	5
5	5
27	4
22	4
25	4
30	4
29	4
24	4
7	4
12	3
21	3
3	3
31	2
5	2
1	1
14	0

Table 14. Gains Made on Repetition of Pre-Test

Pupil	Gain
9	10
16	0
20	0
4	0
11	0
12	0
15	0
22	0
23	0
30	0
32	0
33	0
34	0
35	0
7	0
8	0
3	0
31	0
1	0
14	0

C. Pupil Reactions as Revealed by Their Answers to a Questionnaire.

Since this topic was presented to these pupils in a manner quite different from that to which they were accustomed, and since considerable time and thought had been put into it, it seemed worthwhile to make an effort to ascertain their reactions to this method. Accordingly, after the close of formal work on the unit, a questionnaire was given them, a copy of which follows this page. They were told to answer as they felt, and not to try to give merely tactful answers. Only twenty-six of the class filled out this questionnaire, as four had left and one was absent. A brief summary of their answers is given on the pages following the copy of the questionnaire.

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Algebra I Questionnaire

1. Do you like this type of assignment? Why?

2. What seems to you to be the most valuable feature of this assignment?

3. What seems to you to be the least valuable feature of this assignment?

4. Do you feel that this type of assignment has any advantages for you over the usual daily assignment? Any disadvantages? State what?

5. Did the optional activities help you to see the importance of this topic and its relation to other subjects?

6. Have you been able to keep track of your progress during this assignment better than in previous topics?

7. Since self-direction is one of the goals of education, do you feel that a series of assignments such as this would help you to improve this ability?

8. Does this assignment as outlined enable you to tell more definitely what you should be trying to learn than in previous assignments?

9. What specific operations with fractions have you learned to handle during this assignment?

10. Can you make any suggestions which would improve the effectiveness of this assignment?

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To question one "Do you like this type of assignment?", eighteen answered in the affirmative and eight in the negative. The reasons for their answers were necessarily not of a nature to be tabulated. Those who liked it said that it gave them a chance to plan their work ahead, that they could work at their own rate, that they knew better what they were trying to learn, that they got more self-satisfaction, and that they could take a progress test as soon as they thought they were ready for it. For the most part those who answered in the negative said they did not like the responsibility for planning their own work, or that they were inclined to put off doing the work.

To question two "What seems to you to be the most valuable feature of this assignment?", the most common answers were:

1. The opportunity to work at their own rate.
2. Having to plan their own work.
3. Knowing in advance what work is to be done.
4. Knowing what progress you were making.
5. The fact that one could do more practice work and take a second test.
6. The chance to keep ahead of the rest of the class.
7. The realization that if one doesn't study he will not pass the progress test.

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To question three "What seems to you to be the least valuable feature of this assignment?", there were very few responses. A few of the less able members of the class thought they should have been checked each day; that is, they preferred to hand in a daily paper. Some felt that they could spend an indefinite amount of time on one process, and so progressed too slowly.

The fourth item "Do you feel that this type of assignment has any advantages for you over the usual daily assignment? Any disadvantages? State what?", had already been fairly well covered in the previous three by most of the class. Some said that they received more individual help from the teacher than usual. Others said it gave them a chance to use their own initiative. The disadvantage to a few was that at first they thought they could take it easy by this method, but later found that they were only fooling themselves.

In regard to question five "Did the optional activities help you to see the importance of this topic and its relation to other subjects?", since only a small portion of the class did any of these, and since only one period was used for reporting on them the response was not too favorable. However, those who did do any of these activities found them to be very much worthwhile. The activity showing the relation of factoring to fractions was the most useful one

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for most of the pupils.

To question six "Have you been able to keep track of your progress during this assignment better than in previous topics?", the answers were: yes - twenty-two; no - four. Those answering 'yes' said they knew after each progress test what their score was and what to do next. Those who answered 'no' gave no reasons.

Question seven "Since self-direction is one of the goals of education, do you feel that a series of assignments such as this would help you to improve this ability?", was answered affirmatively by twenty-two, negatively by three, and one didn't know. One pupil remarked that this method not only gave them a chance to use their own time to good advantage, but that it removed the pressure which is present in all other classes.

Question eight "Does this assignment as outlined enable you to tell more definitely what you should be trying to learn than in previous assignments?" was answered in the affirmative by twenty-one, in the negative by three, and two didn't know. Those who commented said that the study guide helped them. Others said that the progress tests made it clear as to what they should have learned.

To quite a number question nine "What specific operations with fractions have you learned to handle during this assignment?" was not clear. Those who did answer gave a more or

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CHAPTER IV

CONCLUSIONS

One cannot spend the amount of thought and energy involved in all of the foregoing without coming to some conclusions as to its value. These have been influenced not merely by the experiences incurred during the teaching of this unit, but also by comparison with impressions gained from fifteen years of teaching by the conventional method of daily assignments.

In the first place it seemed that the class as a whole learned fully as much about fractions as any comparable class would have under the usual manner of teaching. Further than this the small group of pupils who completed one of the optional activities, seemed to have a better general grasp of operations involving fractions, and of their general relation to other subjects than would usually be found. They did this activity because it seemed worth while and because they wanted to, not because they had to do it.

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good foundation in planning more units for actual use. So far as this particular unit is concerned, there are several changes that should be made before it is again used. First, the pre-test should be revised to parallel more closely the types of work which are to be studied in the unit. The amount of space given to mixed expressions on this test was too large, and that to addition and subtraction of fractions was too small. Also, some of the progress tests should be revised. The first of these tests does not fully check on all the pupil needs to know about equivalent fractions. The third test likewise needs revision, as it is too short to be conclusive. A third place for revision of this unit, and a major one, would be in the study guide. More definite assignment of practice work throughout would have helped practically all pupils. Also, a more complete check as to the amount of practice work done should be made before the pupil is allowed to take a progress test.

The size of the class involved, thirty-one pupils, made it a little awkward to handle at first, but both the teacher and the class managed to adapt themselves to the change after a few days.

Another matter shown by the experience gained during this unit to be of great importance, is the way in which the unit is introduced, especially if this method has not been used previously with the class. Sufficient time must be taken to

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During the laboratory phase of the unit, it would seem that definite days, perhaps three a week, on which progress tests could be taken would reduce some of the class confusion, especially in a large class. Perhaps with more experience in using this method greater use could be made of pupil teaching by the more advanced pupils.

One of the greatest advantages of this method is the fact that one can make a comprehensive report on the achievement of each pupil. Thus one can tell from the individual progress tests and from the mastery test just what operations and understandings have been mastered, and which only partially or not at all. This is a big gain for everyone concerned. The pupil or his parents can be shown in detail what the situation is, and the teacher is then in a position to give definite advice.

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